Controlling Metallic Mercury Exposure in the Workplace

A Guide for Employers

Occupational Disease & Injury Services

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Introduction

The purpose of this publication is to provide comprehensive information to ensure that everything possible is done in the workplace to prevent or reduce the pain and suffering caused by mercury exposure. Pages four to nine of this document contain a systematic nine-step framework for assessing and controlling mercury exposure. Appendices A through F and Appendices 1 through 6 contain additional information on a variety of mercury-related topics and are attached at the end of the document and referred to throughout. A **Resources** section on page 10 lists sources of additional information and assistance for employers.

Mercury metal is a silver-gray liquid. Because of its unique properties as a liquid metal, metallic mercury is especially challenging to control. When exposed to the air or if spilled, mercury metal vaporizes into the air where it can be breathed into the lungs. The warmer the temperature, the more quickly the mercury gets into the air. A temperature increase from 64.4°F to 78.8°F doubles mercury's vapor pressure. Mercury can also be absorbed or injected through the skin but is not usually harmful if swallowed unless it becomes lodged in the digestive system. If spilled mercury is not cleaned up completely, it easily gets spread around. Mercury forms droplets that can accumulate in the smallest spaces like cracks between floorboards and under fingernails. These droplets are very slippery and hard to remove from work surfaces or skin. If there is contamination of a worker with mercury, a micro environment of mercury vapor is created around that worker that can give exposure greater than that attributable to the general work environment. Mercury can be spread around work, car, and home from shoes, clothing, hair and other objects with tiny drops of mercury metal on them.

Some of the places mercury metal is found are:

- **thermometers, thermostats, barometers, electrical switches**
- **dental fillings and medical equipment**
- **some light bulbs, including fluorescent, high intensity, mercury vapor high-pressure sodium, and metal halide**
- **some clock pendulums,**
- **some athletic shoes, toys, and cards that light up or make noise.**
- **electrical applications in several manufacturing processes**

Health Effects

Breathing mercury metal vapor over time affects the human **brain, spinal cord, eyes, and kidneys**. Inhaled mercury vapor may cause mood changes; inability to concentrate; memory loss; a fine shaking, tingling, or loss of feeling of the hand, tongue, or eyelid; discoloration of the cornea and lens of the eye; disturbances of vision; and kidney disease.

Breathing a lot of mercury metal vapor in a short time can **poison quickly**. Symptoms begin with cough, chest pain, trouble breathing, and upset stomach. Chemical pneumonia, which can be fatal, can then develop.

Children are more susceptible than adults to mercury poisoning and can be affected if mercury is carried home on clothing, skin, or hair. With significant exposure, children can get "**pink disease**" with a rash over the body, chills, swelling and irritation of hands, feet, cheeks, and nose, light sensitivity, trouble sleeping, and heavy sweating.

Before You Begin: Can You Find a Substitute for Mercury?

Do you really need to use mercury? Can you reduce your use? Can you use a mercury compound rather than metallic mercury? Can you use another metal or alloy in place of mercury? Can you eliminate or replace equipment or instruments which contain mercury? Substitution for mercury has the advantage of completely removing mercury from the workplace, provided that old contamination is eliminated. Be sure, however, that any substitute will be able to be used safely.

Your Company's Health and Safety Program is Important

Mercury control will be more effective if you have a program and staff for the management of *all* workplace health and safety issues. That way it will be easier to decide who should carry out Steps 1 to 9 involved in controlling mercury exposure which are described in this document. In order to deal successfully with mercury and the whole range of

For more information on this subject see:

- **OSHA voluntary Safety and Health Program Management Guidelines**
- **OSHA Program Evaluation Plan**

hazardous substances and conditions in your workplace, you need a health and safety program, with the following four components:

Management Commitment

* Illness and injury prevention as a goal
* Voluntary OSHA compliance
* Health and safety staff with sufficient:
    - Responsibility
    - Authority
    - Staffing levels
    - Competence
* Appropriate use of consultants
    - Private
    - free OSHA consultation
* Adequate health and safety budget

***For more information on this topic see*:**

- **Selecting and Using a Hygiene Consultant** *(Appendix C)*
- **Make sure you and the consultants know exactly what they are being employed to do**
- **Work with consultants rather than leaving them to do the task in isolation**
- **Act on the recommendations proposed**

Employee Involvement . . . . . .

* Joint worker-management health and safety committee
* Employee training and education
* Employee access to medical and exposure data

Hazard Identification

* Record-keeping/200 Log analysis
* Accident/incident/spill investigation

Implementing Controls

* Short and long-term plans
* Company health and safety manual of policies and procedures
* Enforcement of policies and procedures
* Preventive maintenance
* Prompt repairs of broken control equipment

A Systematic Framework for Controlling Mercury Exposure

Step 1. Gather information about the work which involves mercury and the working practices.

For assistance in completing Steps 1 & 2 use:

- **Worksheet for Gathering Information About Work Involving Mercury (***Appendix D)*

All the locations in the workplace where mercury is used or present.

Number of employees on each shift working with or near mercury. Consider all workers, those directly exposed as well as those with "bystander" or indirect exposure. Consider the following types of workers:

* Permanent
* Temporary
* Housekeeping
* Maintenance
* Research and Development
* Crane, forklift, and truck drivers
* Supervisors and managers
* Office, administrative, and clerical
* Storekeepers
* Shipping and receiving
* Contractors
* Interns and students
* Visitors and customers

Job titles, job duties:

* Break down duties by how often they are done (frequency in days/week) and how long they go on for (duration in hours/day)

Work locations: departments, processes, floors, machines, work stations

Usual, occasional, overtime, emergency work shifts

Typical and atypical activities

* Breakdowns
* Staff shortages
* Changes in personnel
* Changes in volume of production
* Trial runs
* Adverse weather

Step 2. Observe and conduct interviews to find out how employees might be exposed.

Evaluate the risk of exposure occurring from each activity.
Consider the potential for ***skin absorption*** of mercury in each activity:

* Direct contact with mercury
* Splashing or spilling onto skin
* Handling objects which have touched mercury
* Contamination of inside of gloves, clothing, shoes, jewelry, eyeglasses
* Contamination of skin when gloves, clothing, shoes are put on or taken off
* Failure to wash skin, fingernails and hair at end of work shift.

Consider the potential for ***inhalation*** of mercury vapor in each activity;

* Contamination of hair, face, skin, clothing, gloves which vaporizes, ... especially in the breathing zone
* Contamination of work surfaces, floors which vaporizes
* Room temperature above 68°F
* Open containers from which mercury may vaporize
* Sources of heat which increase mercury vaporization
* Contamination of cigarettes which are smoked
* Contamination inside respirators
* Improperly selected, maintained, or used respirator
* Improperly designed, maintained, or used ventilation.

Consider the potential for mercury to be ***injected*** into the body:

* Using high pressure equipment
* Handling contaminated sharp objects such as broken glass.

Consider the potential for contamination of employees' automobiles.
Consider the potential for contamination of employees' homes.
Reveal mercury on work surfaces, floors, clothing, hair, etc. using sulfur powder and a flashlight.
Use a direct reading mercury vapor meter to detect the presence of mercury on work surfaces, floors, clothing, hair, etc. *(See list of mercury vapor meters in Appendix 3)*.
Use smoke generator or incense and a floor plan to track air movement inside and out of areas using mercury by observing the movement of smoke and/or odor.
Check to be sure that there is enough make-up air to replace the air being exhausted. If not, doors will be difficult to open or close and there will be drafts through open doors and windows. Ventilation systems will not function properly.

Step 3. Observe employees at work and conduct employee interviews to find out what controls are in place to prevent mercury exposure, using the following menu of controls.

. . . . . .

Isolated/regulated area for use:

* Close doors
* Restrict entry to essential workers
* Restrict time in area
* Restrict movement of air out of area

Control technology/work station design:

* Glove box
* Lab hood . . . . . .

* Temperature control below 20°C (68°F)
* Purchase mercury in containers sized for particular process needs and sized to fit enclosed addition systems
* Store and transfer mercury-containing items in covered containers
* Continuous fixed monitor/alarm set at ½ the ACGIH TLV
* Smooth, impermeable work surfaces (stainless steel) with drainage trough along the front work surface sloped to a collection bottle and a lip along the other sides to prevent spillage
* Smooth, impermeable floors (epoxy, polyurethane, vinyl sheeting); no wood, carpeting or doormats
* Dark colored floors to aid in visualizing mercury
* Caulking around table legs and the space where floors meet walls
* Mercury kept in non-breakable, closed containers and/or stored under water or oil.

Standard written work practices/operating procedures.

Job training. . . . . .

Spill clean-up procedures.

Local exhaust ventilation.

Dilution ventilation.

For assistance in completing Step 3, use:

- **A simple floor plan to note the location of controls as you walk through the workplace**
- **Worksheet for Gathering Information About Controls for Metallic Mercury *(Appendix E)***

For more information on this topic see:

- **A Basic Guide to Industrial Ventilation**
- **NIOSH 1984 Survey of Health Hazard Control Systems for Mercury Use and Processing**

(*Both available from the NJDOH***)**

Housekeeping equipment and procedures

* Daily cleaning of floors, work surfaces, and all hand-contact points (tools, door knobs, table tops)
* Clean up spills promptly *(See Appendix F)*
* Vacuum regularly with a mercury vacuum *(See Appendix 2)*
* Prohibit dry sweeping or wiping
* Prohibit the use of compressed air for cleaning
* Prohibit the use of vacuum pumps
* Used wipe rags and paper towels should not be rehandled, reused, put in pockets, or dried on heaters.

Eye and face protection.

Emergency eye and body wash.

Daily clothing and glove changes.

Respiratory protective equipment and practices *(See Appendix 5)*.

The improper use of personal protective equipment, especially respirators, is dangerous. Such equipment requires a lot of back-up in training, supervision, and maintenance and should only be used if :

- **Workplace exposures are properly assessed**
- **The equipment is properly selected, fitted, maintained, and used**
- **Employees are trained concerning why, when, and how to use the equipment**

Change room and locker room facilities and practices:

* Provide clean storage for street clothing, shoes, and personal belongings during work time
* Prohibit personal belongings in work areas (street clothing or shoes, combs, purses, rings, watches and other jewelry, wallets).

Hand washing and showering facilities and practices:

* Keep lavatories clean
* Provide soap, disposable towels, fingernail brushes, and warm water
* Provide additional hand-washing facilities in work areas
* Keep showers clean and provide soap, shampoo, fingernail brushes, . . . towels, and warm water
* Assure that employees shower, wash their hair, wash their fingernails, and clean their eyeglasses before going home.

Lunchroom facilities and practices:

* Provide clean storage for food, beverages, cigarettes, gum, etc.
* Prohibit eating, drinking, and smoking in work areas
* Assure that employees wash hands and face prior to eating, drinking, smoking
* Require vacuuming of clothing and shoes before entering lunchroom
* Vacuum lunchroom daily with mercury vacuum.

Medical surveillance.
Biological monitoring.
Medical removal from exposure.
Hazard communication:
* Inventory of hazardous materials
* Labeling of containers
* Warning signs.

For more information on this topic see (Appendix B):

- **Recommended Medical Monitoring for Workers Exposed to Metallic and Inorganic Mercury**

Step 4. Decide what additional controls can be implemented, using the Step 3 menu of possible controls.

There are many possible work activities involving mercury and the range of effective controls is equally extensive. However, the Step 3 menu of possible controls should direct your thinking to many of the relevant possibilities. Workplace controls are better than personal protective equipment; this is known as the *Hierarchy of Controls*. Some things, like good housekeeping and hygiene should always be in place. Control technology should be used as needed. Respirators and other personal protective equipment should be used only when other controls are not sufficient.

The Hierarchy of Controls

- Substitute a safer chemical
- Substitute a safer process
- Mechanize the process
- Isolate the process
- Enclose the operation
- Provide exhaust ventilation
- Provide general ventilation
- Provide respirators, gloves, and other protective equipment

Step 5. Make a record of the assessment.

Record sufficient information to show why decisions about exposures and controls have been made. If it has been decided that there will be reliance on personal protective equipment, then the assessment should make it clear why other means were not implemented or sufficient.

Step 6. Make sure you have complied with OSHA regulations

The following OSHA Regulations are applicable to most situations involving the control of mercury exposure. Call the OSHA publications office at 202-219-8151 for copies of the publications listed below which give simple explanations of each standard.

1910.134- Respiratory Protection-See OSHA Publication 3079, Respiratory Protection

1910.132- Chemical Protective Gloves and Clothing- See OSHA Publication 3077, Personal Protective Equipment

1910.1200- Hazard Communication- See OSHA Publication 3084, Chemical Hazard Communication

1910.120- Spill clean-up/emergency response- See OSHA Publication 3088, How To Prepare for Workplace Emergencies

1910.20- Access to Medical and Monitoring Data- See OSHA Publication 3110, Access to Medical and Exposure Records

1910.1000, Table Z-2- Acceptable Ceiling Concentration for Mercury

1904.1 to .22- Recording and Reporting Occupational Injuries and Illnesses- See OSHA Publication entitled *Recordkeeping Guidelines for Occupational . . . Injuries and Illnesses*

Step 7. Budget funds for controls and implement changes

Step 8. Check on the effectiveness of controls.

Review steps 2 and 3.
Conduct full shift personal sampling and compare to ACGIH TLV.
Conduct wipe sampling of work surfaces and skin.
Review step 4, if necessary.
Assess employees automobiles and homes, if necessary.

For more information on this topic see:

- **Mercury in Air Exposure Limits** *(Appendix A)*
- **Mercury Industrial Hygiene Monitoring Methods** *(Appendix 3)*

Step 9. Review Steps 1-8 if plant, process, operations, control methods, or materials change, or if health effects or elevated biological monitoring results are reported.

This does not mean that the whole assessment process will have to be repeated. The purpose of the review is to see if the existing assessment is still suitable and sufficient. If it is, then it is not necessary to do any more. If it appears that the assessment if no longer valid, only those parts of it that do not reflect the new situation need updated.

Resources

Free on-site consultation is available by calling the New Jersey Department of Labor, OSHA Consultation Services at 609-984-3507

OSHA publications are available by calling 202-219-8151, fax 202-219-9266. To see everything available, ask for the OSHA publications catalog

OSHA telephone consultations are available from your local OSHA Area Office: *Marlton* 609-757-5181; *Avenel* 908-750-3270; *Parsippany* 201-263-1002; *Hasbrouck Heights* 201-288-1700

NIOSH publications are available by calling 513-533-8287

NIOSH telephone consultation is available at 1-800-35-NIOSH

Listing of proficient industrial hygiene labs appears in the **American Industrial Hygiene Association Journal** every March, June, Sept, Dec.

Listing of industrial hygiene consultants appears in the **American Industrial Hygiene Association Journal** every January and July

Directory of Occupational Medicine Services is available from NJDHSS at 609-984-3565

Training is available from the Environmental and Occupational Health Sciences Institute at UMDNJ at 908-235-5062

OSHA Handbook for Small Business. $4.00 from the Government Printing Office, 202-783-3238, Publication 029-016-1-441

Industrial Pollution Prevention helps employers find safer substitutes for hazardous chemicals and processes. NJ Institute of Technology, 201-596-5864

NIOSH 1984 Survey of Health Hazard Control Systems for Mercury Use and Processing is available from NJDHSS at 609-984-3565

A Basic Guide to Industrial Ventilation is available from the NJDHSS at 609-984-3565